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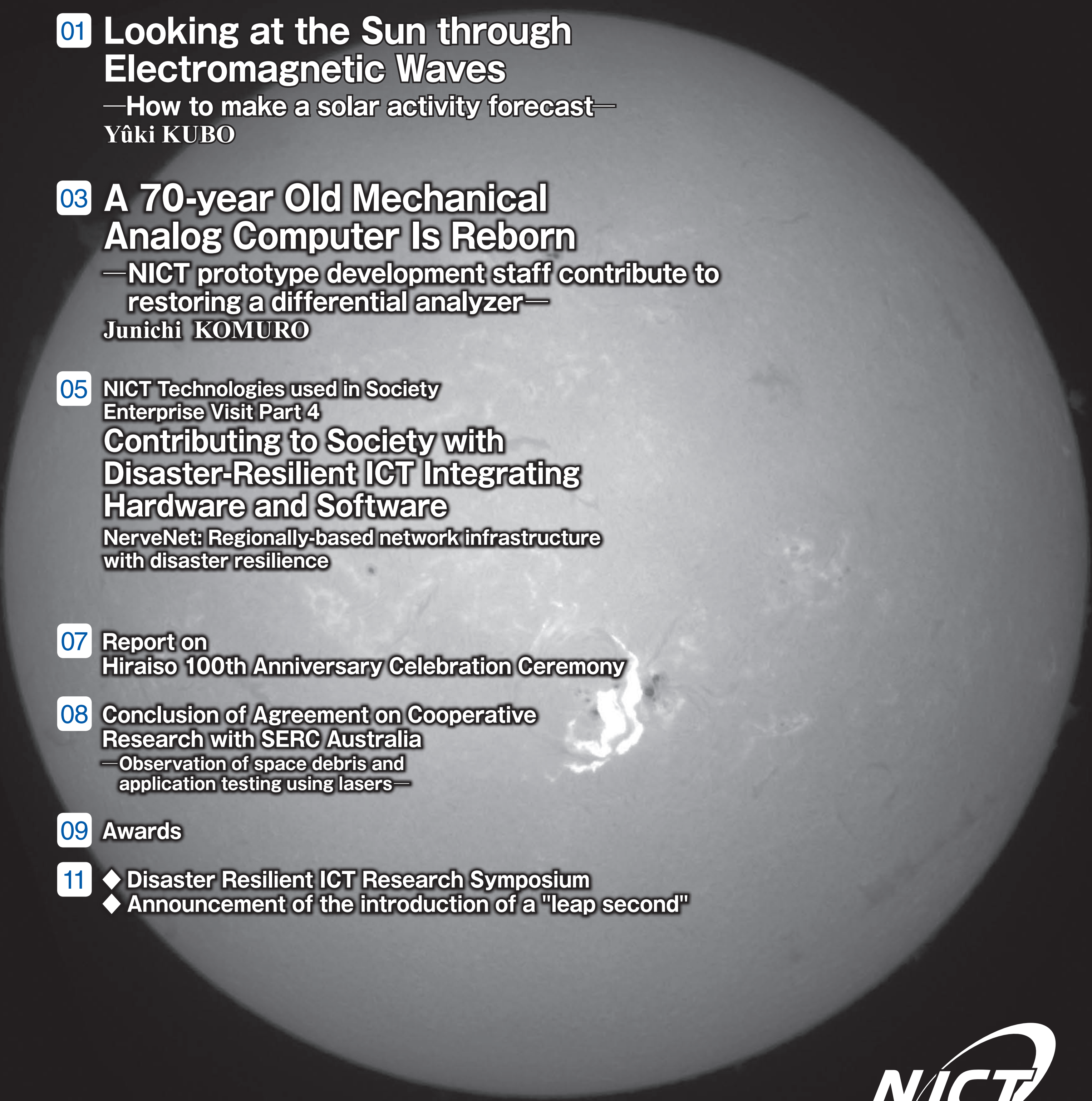

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Cover image: The Sun During a Large-scale Solar Flare
(photographed using a telescope at the Hiraiso Solar Observatory)

Looking at the Sun through Electromagnetic Waves

—How to make a solar activity forecast—

Yûki KUBO

Senior Researcher, Space Weather and Environment Informatics Laboratory, Applied Electromagnetic Research Institute

After completing his master course in 1998, joined the Communications Research Laboratory, the Ministry of Posts and Telecommunications (currently NICT). Engaged in solar radio observation and research on solar activities related to space weather forecasting. Ph.D.

Introduction

NICT issues space weather forecasts and warnings every day, 365 days a year. This information may not yet be well known generally, but it is gradually coming into use in social life. For example, the International Civil Aviation Organization (ICAO) has recently begun actively discussing mandatory use of space weather forecasts while operating an aircraft. There are three main ways that space weather information is seen as important for operation of aircraft. The first is to avoid communication failure between the aircraft and air-traffic control, the second is to prevent increase of measurement error in aircraft positioning for electronic navigation, and the third is to reduce health effects on flight crews due to exposure to galactic cosmic rays and solar energetic particles. Space weather information is making its way into our lives in society in this and other forms, but it is still not very familiar compared to terrestrial weather forecasting, so people do not often have a good understanding of forecast content. In this article, we will give a simple description of the basic knowledge required to understand the space weather forecasts provided by NICT. In particular, we give a simple explanation of solar flare forecasts and alerts, the data on which they are based, and the significance of the information we issue.

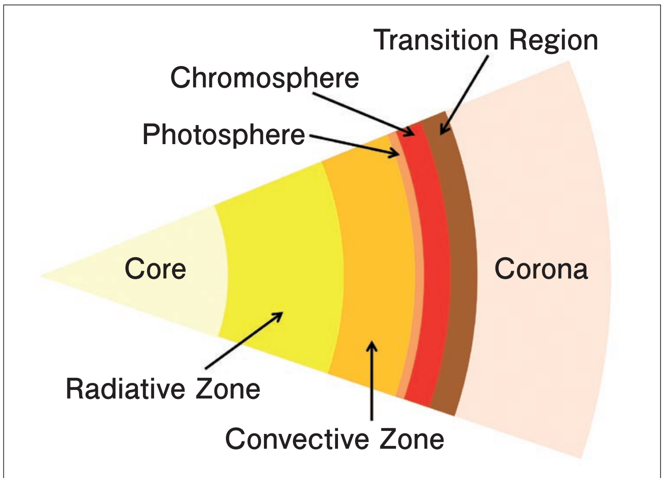


Figure 1 Structure of the sun
The photosphere is a thin layer that is generally thought of as the surface of the sun, and outside of it are layers called the chromosphere, the transition region, and the corona. Inside the photosphere from inside out are the core, the radiative zone, and the convective zone (Note: layer thicknesses are not to scale.).

The sun and solar activity

Astronomically speaking, the sun is an ordinary star and there are countless others like it in the universe. The sun is a sphere composed of mainly of hydrogen and helium gases, and has a layered structure as shown in Figure 1. The thin layer labeled "Photosphere" in the figure is the layer that can be seen by visible light and that human eyes can see when looking at the sun, so it represents what is generally called the surface of the sun. Black points in the photosphere (see Figure 2 (a)), are called sunspots, and are areas where the magnetic field is stronger compared to the surrounding regions. The outer layers of the sun, outside of the photosphere, include the chromosphere, the transition region, and the corona. Most phenomena related to space weather forecasting occur in the outer layers of the sun, so we will omit an explanation of the interior of the sun at this time.

Recently, it has become more common to hear reports that "there are more sunspots, so the sun is active." So why does more sunspots indicate that the sun is active? A typical activity of the sun is the explosive phenomena in the outer layers of the sun called solar flares, and in fact, most solar flares occur in areas surrounding sunspots. Thus, solar flares tend to occur more frequently when there are more sunspots, and we say that the sun is more active.

Looking at the sun with various electromagnetic wavelengths

The sun is always emitting electromagnetic (EM) wavelengths over a wide range besides visible light, so we can see the complex structure of the outer layers of the sun by looking at it with various EM wavelengths. Figure 2 shows images of the sun observed by artificial satellite on January 7, 2014, at about 18:30UT (Universal Time). Image (a) is the sun as seen with visible light, showing the photosphere as described above. Sunspots can be seen clearly when viewing the photosphere in visible light, so it is used to discern fluctuations in sunspots. Image (b) is also the sun seen with visible light, but it has been observed using the Zeeman effect, which enables observations of the magnetic field of the photosphere. Large scale solar flares often occur when the magnetic field around a sunspot has complex structure, so these images are important for observing changes in magnetic field complexity around sunspots. Image (c) shows the sun observed at the ultraviolet wavelength of 304 Å. It gives a good view of the chromosphere, just slightly above the photosphere. The dark lines that can be seen in the figure are

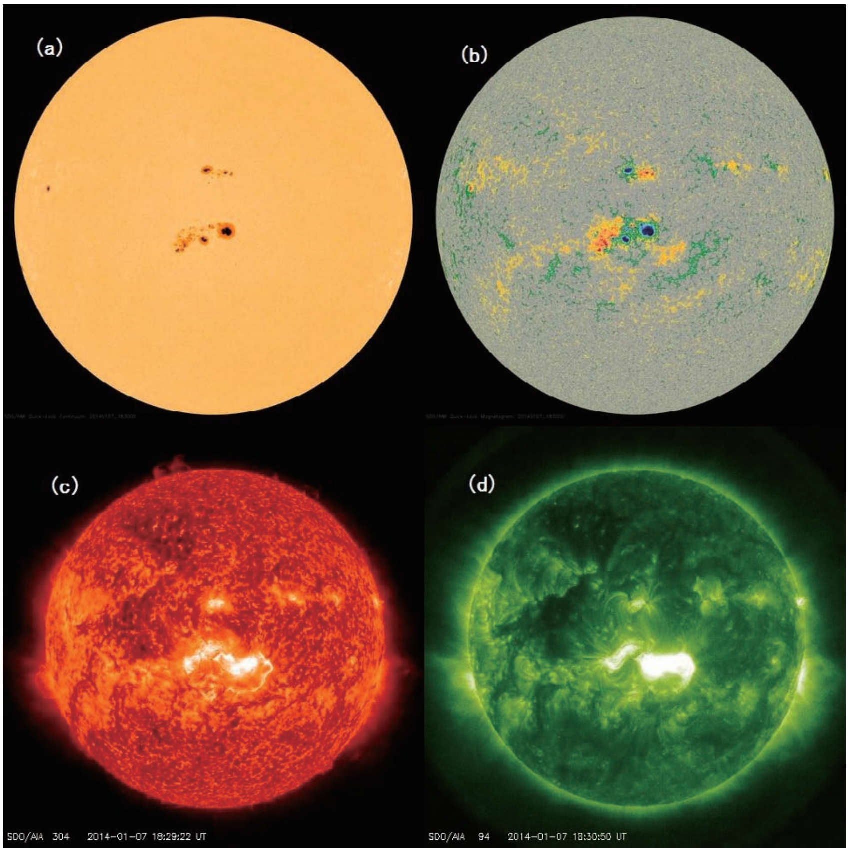


Figure 2 The sun on January 7, 2014, at 18:30UT, observed using various electromagnetic wavelengths

(a) Photosphere observed with visible light, (b) Photospheric magnetic field observed with visible light using the Zeeman effect, (c) Chromosphere observed using ultraviolet of wavelength 304 Å, (d) Corona viewed with ultraviolet of wavelength 94 Å (Images provided by NASA).

called filaments. When a filament erupts toward the earth, coronal plasma is ejected with it, and together they collide with the earth one to three days later, disturbing the earth's magnetosphere. For this reason, knowing when filaments erupt is very important for space weather forecasting. Image (d) shows the sun observed at the ultraviolet wavelength of 94 Å. At this wavelength, the corona, still higher above the chromosphere, can be seen clearly. Solar flares also shine clearly at this wavelength (the bright part in the center of the image), so it is easy to see where on the sun a solar flare has occurred. This observation is important in determining the scale of effect it will have on the earth. The activity on the sun can be studied in greater detail with observations at various other EM wavelengths such as X-rays, radio waves, and infrared, but we omit description of these at this time.

We use this sort of solar observation data to determine the level of activity on the sun and issue reports such as whether solar activity is Quiet or Active.

Space weather forecasts issued by NICT

NICT issues three types of space weather forecast as defined by the International Space Environment Services (ISES), as well as other original forecasts. Here, we will give a simple explanation of solar flare forecasts, one of the three types of forecast set by ISES.

The sun is always emitting X-rays, even when it is quiet, but when a large scale solar flare occurs, X-rays at 100 to 1,000 times as much as during quiet times pour down on the earth. Figure 3 shows the fluctuation over time, of X-ray flux from the sun on the earth at wavelengths from 1 to 8 Å, as observed by the Geostationary Operational Environmental Satellite (GOES). The scale of a solar flare is defined by the maximum X-ray flux during the flare, as shown in Table 1. For example, if the maximum is 7.2×10^{-5} Watts m^{-2}, the flare is called an M7.2 flare. Figure 3 shows that from January 7 to 8, 2014, there were some relatively large-scale solar flares of M and X class (black arrows). Solar flare forecasts provide official information on flares predicted for the following 24 hours, according to the predicted maximum class of the solar flares, as "Quiet", "Eruptive", "Active", or "Major Flare". For the actual forecast issued from NICT at 6:00UT on January 7, the solar flare forecast was "Active", but an X1.2 flare occurred at about 18:00UT, so the actual condition was "Major Flare". It is currently extremely difficult to predict the occurrence of a major solar flare, and none of the five countries actively issuing solar flare forecasts were able to anticipate the X-class flare that occurred on the 7th.

Solar flares are closely related to ionospheric disturbances, so accurate solar flare predictions are needed to avoid issues such as disruption of wireless communications and danger due to increased positioning error when operating aircraft. To respond to this need in society, NICT continues to consolidate its space environment observation network and to develop space environment simulations, to increase the accuracy of space weather forecasts.

Table 1 Solar flare scale and forecast definitions

Max. X-ray flux (Watts m^{-2})	Solar flare scale	Solar flare forecast
$10^{-8} \leq Fx < 10^{-7}$	A	Quiet
$10^{-7} \leq Fx < 10^{-6}$	B	Quiet
$10^{-6} \leq Fx < 10^{-5}$	C	Eruptive
$10^{-5} \leq Fx < 10^{-4}$	M	Active
$10^{-4} \leq Fx$	X	Major Flare

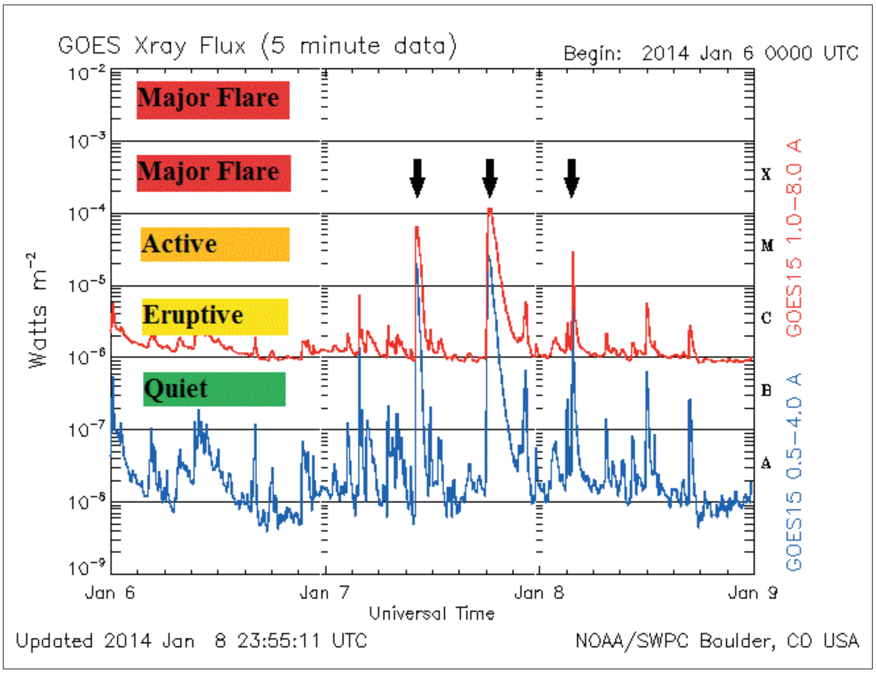


Figure 3 X-ray flux from the sun to the earth as observed by the Geostationary Operational Environmental Satellite (GOES). Solar flare scale is defined based on the X-ray flux at wavelengths from 1 to 8 Å (red plot) in increasing size classes, A, B, C, M, and X (see Table 1). Relatively large solar flares of M and X class are shown by the black arrows (Images provided by NOAA, with some modification.).

A 70-year Old Mechanical Analog Computer Is Reborn

—NICT prototype development staff contribute to restoring a differential analyzer—

Jun-ichi KOMURO

Expert, R&D Activities Support Office, Outcome Promotion Department

Joined the Radio Research Laboratory, the Ministry of Posts and Telecommunications (currently NICT) in 1979. Since then engaged in prototype development work.

Introduction

The NICT Outcome Promotion Department, R&D Activities Support Office performs the task of prototype development to support R&D, manufacturing new components that are not available on the market when they are needed by NICT researchers for their research. In 1999, our prototype development staff repaired and restored an embossing Morse telegraph machine. It is an important cultural property at the Postal Museum of Japan that was presented to the shogunate at the end of the Edo era by Commodore Perry when his black ships arrived. This skill in restoration was recognized, and we were consulted on the restoration of a mechanical analogue computer, called a differential analyzer, and the only such device existing in Japan. This began a process that in July, 2013, resulted in a joint research agreement titled, "Study of physical computing utilizing a differential analyzer, and applications in education," between NICT, Research Organization of Information Systems, National Institute of Information (NII), and Tokyo University of Science (TUS).

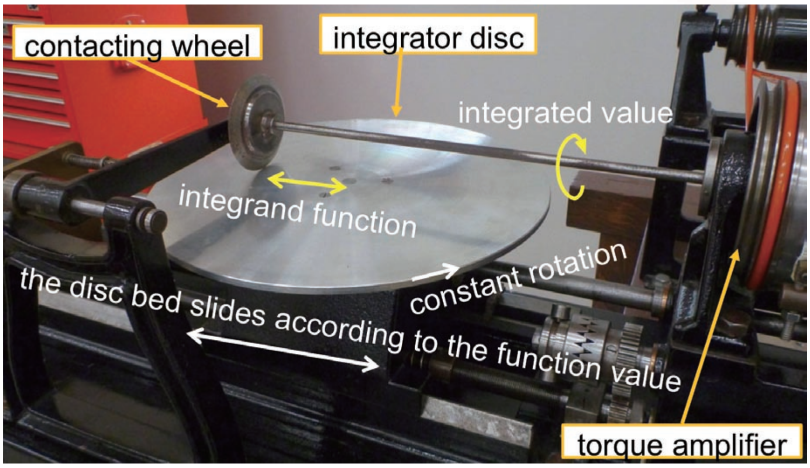


Figure 1 The integrator and the torque amplifier

What is a differential analyzer?

To solve a differential equation, the reverse operation, or integration, is needed. A differential analyzer is a large mechanical analog computer that solves ordinary differential equations using integrators and other components. The principles of this device were invented in 1887 by James Thomson from the UK. A practical implementation was completed in the form of a generally applicable computing device by Vannevar Bush in 1931. Before the war, three such machines were built in Japan, for use in aircraft design and other applications. One of these devices was used by Prof. Tatsujiro SHIMIZU (1887–1992) at Osaka Imperial University, for research on non-linear differential equations. Prof. SHIMIZU later moved to TUS in 1961, and the device was moved with him. It is now the sole such differential analyzer in Japan. During the move to TUS, it was disassembled and iron parts were exposed, resulting in loss and rust on components so it no longer worked. Nevertheless, the TUS Museum of Science carefully re-assembled it, preserved it with clear lacquer, and exhibited it from about 1993 on. This differential analyzer was recognized as an "Information Processing Technology Heritage" item by the Information Processing Society of Japan (IPSJ). Information Processing Technology Heritage items are items of computer technology or products recognized to have had a notable effect in the history of computer technology development in Japan, whether in terms of important R&D results, in the lives of citizens of Japan, economically, in society or culturally.

Five years ago, Dr. Eiiti WADA, Emeritus Prof. at University of Tokyo and Research Advisor of the IIJ Innovation Institute, received notice that a differential analyzer once used at Manchester University in the UK had been restored. Wanting to return the differential analyzer at Tokyo University of Science, he started the differential analyzer restoration project in consultation with Dr. Shin TAKEUCHI, Director of the Museum of Science, TUS (at the time); Kazue OOISHI, Curator of the Museum of Science, TUS; Prof. Hiromichi HASHIZUME, NII; Jun UMEZU, NICT; and the author.

Operating principles of the differential analyzer

The most important components of the differential analyzer are the integrators, which are composed of a horizontal disk rotating at constant speed ("integrator disk") and a smaller disk ("contact wheel") oriented perpendicularly and rotating on top

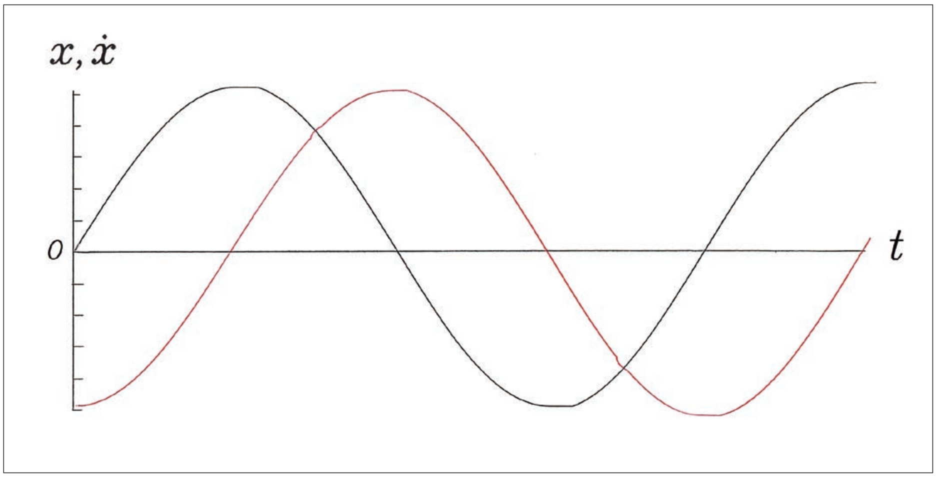


Figure 2 Sinusoidal curves drawn on the output table
($x=-r\cos t$ (red) and $\dot{x}=r\sin t$ (black) are solutions of the differential equation $\ddot{x}=-x$. $(x,\dot{x})$ parameterized by t forms a circle of radius r)

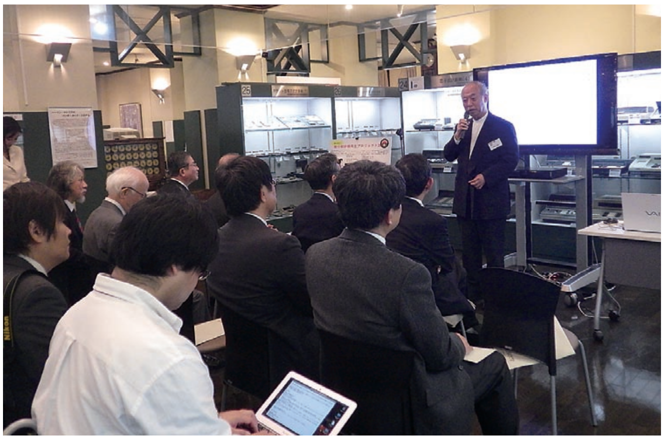


Figure 3 Greeting by President Masao SAKAUCHI at the completion announcement

of the integrator disk (Figure 1). By moving the position where the contact wheel touches the integrator disk along its radius, the rotation speed of the contact wheel changes, getting slower toward the center of the disk, and faster toward the perimeter. The position of contact between the disk and wheel can be changed continuously. The amount of this change can be input by tracing the graph of a function on an input table, which is like a drafting board, and thus the function can be integrated. The torque of the contact wheel is very low, so a mechanical torque amplifier is built into the device. A belt is wrapped around a rotating drum powered by a motor, with one end as the input, and the other end fixed to an arm. When the contact wheel tries to turn, the belt tightens, and the torque is multiplied by nearly 1,000 times.

The differential analyzer that we were repairing and restoring has three of these integrator components, one input table, and one output table, so it is able to solve differential equations up to third order. The results of computations by the differential analyzer are drawn as curves on the output board using two pens. An example of output is shown in Figure 2. Look carefully at where the lines cross. You can see how the red pen diverts slightly so that the pen tips do not collide. This is a pre-war device, but even details such as this were taken into consideration.

Restoration

First, we wanted to create drawings of the entire differential analyzer and created construction drawings by June, 2013, with about 10 students participating in taking measurements. These drawings were useful later when designing parts.

Then, over approximately a year and a half starting in August, 2013, two of the integrators, the output table and the input table, in that order, were brought to the NICT prototype development office, stripped of lacquer, processed and tuned. In particular, the NICT prototype development staff manufactured over 40 different parts that were needed. These included important components such as the nut of the lead screw that moves the disk carriage in the integrators, parts that regulate belt tension in the torque amplifier, the output board spiral gear, drawing pen holders, and the input board holder. For the string and belt used in the torque amplifier, many amplification rate tests were done to determine material properties for each through trial and error. We also had to tune various parts so that they would operate, such as the lead screws used in the input and output boards, which were bent. These had to be mounted in a lathe and measured precisely while straightening them.

Thus, the differential analyzer was repaired and restored after 70 years. Built before the war, this differential analyzer is one of only a few existing in the world from that time, and is the only one in the world today that one can actually touch and operate.

Differential analyzer completion announcement

On December 1, 2014, a meeting was held to announce the completed restoration at the Museum of Science, TUS (Director: Dr. Jin AKIYAMA) (Figure 3). The meeting began with greetings from the directors of the participating facilities, including Dr. AKIYAMA, Director of the Museum of Science, TUS; Dr. Masaru KITSUREGAWA, Director-General of the National Institute of Informatics (NII); Dr. Akira FUJISHIMA, President of Tokyo University of Science, and Dr. Masao SAKAUCHI, President of NICT. These were followed by an explanation and demonstration of the differential analyzer. The circle test used many times in the differential analyzer performance tests was used in the demonstration. The sine and cosine curves shown in Figure 2 were drawn on the output table, and the circle combining these results was displayed enlarged on a screen. Participating reporters were captivated at the sight.

We plan to make arrangements so that we can restore the remaining components and make a working exhibit in the future.

The differential analyzer is currently on exhibit at the Museum of Science, TUS. Computations are performed twice a week, so please come to see the differential analyzer in operation, which we helped to restore.

All participants with the differential analyzer in the foreground

Contributing to Society with Disaster-Resilient ICT Integrating Hardware and Software

NerveNet: Regionally-based network infrastructure with disaster resilience

NerveNet: The registered trademark of a network system that does not make use of cellular phone base stations or other existing communications infrastructure, but uses its own wireless base stations. Each base station automatically detects and connects with other base stations within the range of its signal, and automatically searches for routes to base stations outside of its signal range. This enables the network to quickly secure other routes if part of a route is interrupted, enabling disaster-resilient communication systems to be built. NerveNet can also be used to provide regionally based information infrastructure, when the situation is normal and there is no disaster.

System development for NerveNet was done jointly by Nassua Solutions Corp. (hereinafter "Nassua") and NICT, but recently, NICT completed a formal technology transfer agreement with Nassua and HIRAKAWA HEWTECH CORP. (hereinafter "HIRAKAWA"), laying a foundation for cooperation among the three. Nassua is a venture company established in 2001 and focused on development of network and wireless technology. HIRAKAWA is a medium-sized hardware manufacturer established in 1948 and focused on development and manufacture of wire and electronic equipment. On this occasion, Yasuhiro HASHIMOTO, Specialist, Intellectual Property Promotion Office, Outcome Promotion Department , spoke with Mr. Tohru SANEFUJI, CTO of Nassua and Mr. Yoshio OKA, Sales Manager of Device Sales Group at HIRAKAWA.

NerveNet: Arising from basic research in networking technology

HASHIMOTO: Our theme today is "Contributing to Society with disaster-resilient ICT integrating hardware and software." I think the biggest success here is being able to provide this infrastructure throughout the world, through an integration of software developed by Nassua, and hardware manufactured by HIRAKAWA. Could you tell us about what prompted you to start the development of NerveNet?

SANEFUJI: Originally, as part of developing network related technology, we were developing a mesh network using NICT's 32 GHz wireless testbed in Yokosuka. After that, we were introduced to Masugi INOUE (Research Manager, Network Architecture Group, New Generation Network Research Center at the time). When we asked how we should develop a Broadband Wireless Access (BWA) technology that we had been cultivating, he said we should spend some time together, bringing it from the basic research stage to a practical demonstration. Development of NerveNet began as research on basic network technology before we began discussing disaster resilience.

Mr. Tohru SANEFUJI
CTO of Nassua Solutions Corp.

Mr. Yoshio OKA
Sales Manager of Device Sales Group, Devices Sales Division, Device Department
HIRAKAWA HEWTECH CORP.

NerveNet base station (Tohoku testbed)

Result of cooperation among Nassua, HIRAKAWA, and NICT

HASHIMOTO: In this case, a technology transfer agreement was completed, enabling the three parties to collaborate. What sorts of further development do you think this will lead to in the future?

OKA: Besides our customers in telecommunications and networks, we also have clients in CATV and other broadcasting related industries. Cable channels companies have developed businesses distributing regional information and have close relationships with governments, especially at the local city, town, and village level, so they are developing that aspect of social infrastructure. This led to the idea that we could develop NerveNet as infrastructure as well.

SANEFUJI: We had conducted joint research with HIRAKAWA before this contract, but the contract has formalized how it will work. It is very important for cooperation between the companies. We hope that this will be an opportunity for us to mature our infrastructure as a business.

Use of NerveNet for disaster-resilience

HASHIMOTO: The Great East Japan Earthquake was what prompted us to start serious research on NerveNet and other disaster-resilient ICT. NICT also opened its Resilient ICT Research Center for disaster-resilient ICT in 2012. Building network infrastructure that is resilient against disaster is an important issue for Japan.

What are your thoughts on this issue?
OKA: When the communication networks of communications carriers were interrupted during the earthquake, many people were affected. Also, it took some time before they were restored, so this led to further confusion. NerveNet has mobile base stations as well as fixed base stations. When a disaster occurs, mobile base stations can be deployed, and used for communications infrastructure in isolated areas. Of course, we have no way of knowing where a disaster will strike, so base stations must be located in as many places as possible. Base station cost is also important in implementing this. We want to consider setting prices that will be affordable for all local governments, and to build products that will be cost-effective.
SANEFUJI: When just one location on a freeway is obstructed, the whole freeway stops. We want to build regional networks that are more like ordinary roads rather than freeways. For disaster resilience, it is important to build ordinary roads, so that there are multiple possible routes. The fact that such ordinary routes have not been built is an issue for the networks in Japan.

NerveNet as social infrastructure during normal times

HASHIMOTO: NerveNet is currently being developed for disaster resilience, but services that can be provided during ordinary times are also important.
SANEFUJI: When considering operations during ordinary times, cost is an important issue. With the spread of smartphones, bandwidth is already running short. Bandwidth needs to be increased at access points, rather than the backbone. Also, for applications for which the cost of using the Internet is increasing, such as point-to-point wide-area surveillance, both the cost and insufficient bandwidth issues can be solved at the same time by using NerveNet.
OKA: There is increasing talk of building Wi-Fi spots for use during the 2020 Olympics in Tokyo. We are also considering deploying NerveNet for this sort of application. Another possible application is to install base stations along mountain climbing routes and having climbers carry some kind of tag device, which would provide location data a means of contact, which could be helpful when mountain climbing.

Expanding business with applications where there is a need

HASHIMOTO: NerveNet is currently at the stage of testing and verification, but you will soon need to consider developing business aspects, won't you?
SANEFUJI: As we build understanding of regional needs, we are creating an environment to provide services with NerveNet. To develop businesses in this environment, we need to add value that end users will use.
OKA: The base stations only provide an infrastructure. The purpose or application—what to do with that infrastructure—is also very important. We will develop the business by creating many sample applications, and involving other players who are capable of creating applications.
SANEFUJI: To develop various applications according to regional needs, we will need to form partnerships with a cross-section of system integrators and content vendors. How we will mix with such solution vendors in the future will be an issue, but we want to be open in our cooperation with partners in order to develop the business without breaking our current management style.
OKA: Our strength as a company is in our infrastructure, which

enables us to develop solutions that are not tied to a particular manufacturer's products and to respond rapidly to product development.

Expectation of NICT as a regulator for building a disaster resilient country

HASHIMOTO: What other fields of application besides building disaster-resilient infrastructure do you envision for NerveNet in the future?
SANEFUJI: NerveNet can also be used in the field of intra-networks. In server-client-based communication environments and networks within prefectures or between cities, there is a risk of vulnerability due to servers going down or trunk networks being interrupted. Introducing NerveNet into the core part of the network can enable serverless operation so that any crisis can be decentralized.
OKA: Currently, we are proposing use of wireless base stations, but NerveNet technology is also effective with wired networks. A more robust backbone could be built with a wired mesh network.
HASHIMOTO: Can you tell us any more about development plans and goals between Nassua and HIRAKAWA in the future?
SANEFUJI: In disaster resilience, being able to check on the well-being of others is also important. A disaster message board does not provide access to real-time information. There are also security issues with systems that upload information to the Internet.

If each individual carried a tag, NerveNet could retain information from just before a disaster occurred. This would show where individuals were, and would facilitate rapid search for those that are missing. Of course, implementing such a system would require a cross-sectional framework including levels of local government. We would like NICT to establish a project to institutionalize a platform that could tie such projects together. Building a country that is disaster resilient is a very important theme.
OKA: As a hardware manufacturer, we intend to create wireless device products for NerveNet. We also want to develop the business rationally, including building the necessary systems. Also, as Mr. SANEFUJI has said, a mechanism with tags that people carry to notify of their current location is needed and would be effective for checking the well-being of others. I think it would also be good to extend this to other items that people carry around, such as driver's licenses, so I hope that NICT will also be able to take a role in regulation of this area.

Yasuhiro HASHIMOTO
Specialist, Intellectual Property Promotion Office, Outcome Promotion Department

This concludes our feature on NICT Technologies used in Society: Enterprise Visits. We plan to publish more articles like this from time-to-time in the future.

Report on Hiraiso 100th Anniversary Celebration Ceremony

Space Weather and Environment Informatics Laboratory,
Applied Electromagnetic Research Institute

The predecessor of NICT's Hiraiso Solar Observatory, in Hitachinaka City, Ibaraki Prefecture, was the Hiraiso Branch Office of the Electrotechnical Laboratory, Ministry of Communications, which was established in January, 1915. Thus, as of January, 2015, the Hiraiso Solar Observatory entered its 100th year. To commemorate this NICT held a Hiraiso 100th Anniversary Celebration Ceremony on December 5, 2014.

When it was opened, as Japan's research base for radio communications, the facility conducted observation and research on radio wave propagation. Later it became important for radio propagation forecasts and began observations of the ionosphere and the sun as part of its radio wave reporting duties. At the end of the 1980's, the Space Weather Forecast Project was begun in the area, was inherited by NICT headquarters (Koganei City, Tokyo), and continues to this day. Thus, Hiraiso can be said to be the origin of radio propagation research and space weather forecasting in Japan.

A tour of the Hiraiso Solar Observatory was held on the day, before the ceremony. Fortunately, the weather was fine, and the 50 participants were able to see solar radio observation equipment and the solar optical telescope, which are still in operation. Many former members of Hiraiso participated and were seen walking the premises, reminiscing about the past.

After the tour, participants moved to a neighboring hotel where the 100th Anniversary Celebration Ceremony was held. The ceremony began with a greeting from the host, Masao SAKAUCHI, President of NICT, followed by a greeting from the guest of honor, Mr. Shigeru NAKAYAMA, Director of the Planning Department, on behalf of Mr. Motoki HONMA, Mayor of Hitachinaka City. After these greetings, Mamoru ISHII, Director of the Space Weather and Environment Informatics Laboratory, gave an introduction to the history of Hiraiso and some of its achievements in a talk titled, "Introduction to 100 years at Hiraiso." Finally, President SAKAUCHI presented Planning Department Director NAKAYAMA with a letter of thanks to the city of Hitachinaka, for long years of support.

The ceremony was attended by Mr. Tomoo YAMAUCHI, Director of Space Communications Policy Division, Ministry of Internal Affairs and Communications, as well as visitors from the National Institute of Advanced Industrial Science and Technology, of which the Electrotechnical Laboratory at Ministry of Communications and Transportation was one of the founding organizations, and agencies with a strong research connection, including the National Astronomical Observatory of Japan, the Institute of Space and Astronautical Science, the Japan Aerospace Exploration Agency, and the Kakioka Magnetic Observatory of the Japan Meteorological Agency. There were also researchers from the University of Electro-Communications, and Ibaraki University, as well as former Hiraiso members and current NICT employees. A total of 57 people attended.

A reception was held after the ceremony, and over the meal, participants talked of memories from Hiraiso. There were speeches from many former employees and associates, including Dr. Katsuhide MARUBASHI, a former Director of the Hiraiso Branch, Radio Research Laboratories, and Dr. Tadahiko OGAWA, a former Director of the Hiraiso Solar Terrestrial Research Center. Many enjoyable memories, stories of difficulties and interesting anecdotes were heard. The events of the day truly represented the 100-year history of the facility.

To commemorate this 100th Anniversary of Hiraiso, the Hiraiso 100th Anniversary Celebration Committee plans to publish a magazine summarizing the history of Hiraiso and various stories from former members.

Tour of the Hiraiso Solar Observatory

Hiraiso 100th Anniversary Celebration Ceremony

Conclusion of Agreement on Cooperative Research with SERC Australia

—Observation of space debris and application testing using lasers—

On December 2, 2014, NICT concluded an agreement with the Space Environment Research Centre Limited (SERC) of Australia for research collaboration on "Applications Research on Managing and Eliminating the Risk of Space Debris using Lasers."

SERC is a non-profit, non-military scientific research company, established on July 1, 2014 under the Cooperative Research Centres (CRC) program of the Australian government, and is composed mainly of Australian research facilities and universities. SERC focuses on debris in space environments, and conducts R&D on laser-ranging observations of space debris using new technologies such as high-power lasers, determining orbits, predicting collisions, and eliminating space debris. It also builds and publishes a database, and is networking the observation system. Space debris refers to space garbage, such as satellites and fragments that are no longer needed and are floating in the space environment. It is now becoming a major threat to the safe operation of artificial satellites. NICT is collaborating on hardware and software development regarding debris observations by laser ranging in order to determine orbits and manage a database, as well as conducting applied research using the debris tracking system.

A ceremony to sign the agreement was held, together with the opening of SERC, at the Australian House of Parliament. Approximately 60 people attended, including Mr. Ian Macfarlane, Minister for Industry, Tourism and Resources, others affiliated with SERC, and the Secretary of the Japanese Embassy in Australia. Mr. Brett Biddington, Director of SERC, and Fumihiko TOMITA, Vice President of NICT, signed the agreement, and after the ceremony, there was a tour of the SERC facility, which is at the Mount Stromlo Observatory.

Commemorative photo of the signing ceremony

In a room at the House of Parliament, from the right: B. Greene, CEO of SERC; B. Biddington, Director of SERC; I. Macfarlane, Australian Minister of Industry, Tourism and Resources; F. TOMITA, Vice President of NICT; and H. KUNIMORI, Senior Researcher, NICT.

SERC facility at the Mount Stromlo Observatory

Foreground (left): dome of 2 m telescope; background (center): dome of 1 m telescope.
Approximately 20 min. by car from the center of Canberra, where the House of Parliament is located.

Awards

Recipient ● Keita EMURA/ Senior Researcher, Security Fundamentals Laboratory, Network Security Research Institute

◎Co-recipients
Sanami NAKAGAWA (University of Tsukuba)
Goichiro HANAOKA (AIST)
Akihisa KODATE (Tsuda College)
Takashi NISHIDE (University of Tsukuba)
Eiji OKAMOTO (University of Tsukuba)
Yusuke SAKAI (AIST)

◎Award Date: June 5, 2014

◎Name of Award:
9th ACM Symposium on Information, Computer and Communications Security (ASIACCS) Best Poster Award

◎Details:
Performance Evaluation of a Privacy-Enhanced Access Log Management Mechanism

◎Awarding Organization:
ASIACCS2014 Organizing Committee

◎Comment from the Recipients:

In this research, we proposed an access log management mechanism where no user information is revealed even if logs are exposed, but illegitimate users can be traced when necessary, and estimated the efficiency of the proposed mechanism. This poster presentation is based on the graduate thesis of Ms. Sanami NAKAGAWA. We wish to express sincere thanks to all those providing support in connection to this research.

Recipient ● Jerdvisanop Chakarothai/ Researcher, Electromagnetic Compatibility Laboratory, Applied Electromagnetic Research Institute

◎Award date: August 20, 2014

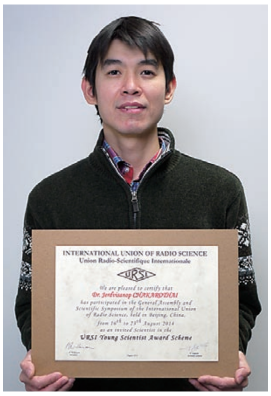
◎Name of Award: Young Scientist Award

◎Details:
In recognition of excellence for the paper, "SAR Assessment of a Human Body Exposed to Electromagnetic Fields from a Wireless Power Transfer System in 10 MHz Band," at the 31st General Assembly of the International Union of Radio Science (URSI-GASS).

◎Awarding Organization:
International Union of Radio Science

◎Comment from the Recipient:

As wireless power transmission technology has advanced, it is being applied in various fields, but wireless power transmission systems handle large amounts of power and produce strong electromagnetic fields in their surroundings. In this research, we performed a quantitative evaluation through numerical analysis, of the electrical fields induced in the body and the electrical power absorbed when a person approaches one of these wireless power transmission systems. We also identified the most severe of various exposure conditions, and were evaluated highly for this. We would like to thank all of those that have supported us in receiving this award, and we hope to contribute to the further development of radio wave safety evaluation in the future.



Recipient ● Kanako WAKE/ Senior Researcher, Electromagnetic Compatibility Laboratory, Applied Electromagnetic Research Institute

◎Award date: August 21, 2014

◎Name of Award: Technological Contribution Award

◎Details:
In recognition of great contribution to activities of the Wireless power transfer systems technology committee.

◎Awarding Organization:
The Society of Automotive Engineers of Japan

◎Comment from the Recipient:

Research on wireless power transfer technology has been advancing recently for electric vehicles and other applications. In implementing these technologies, it is necessary to verify compliance with safety guidelines for people in the vicinity of the equipment. Therefore, we have built wireless power supply systems at the Electromagnetic Compatibility Laboratory, and have been conducting studies on exposure assessment for those systems with numerical simulation and experiments. It is through the support of many people involved in this research that we have received this award. We would like to express sincere thanks to all of them.

Recipient ● Shin-ichiro INOUE/ Director of DUV ICT Device Advanced Development Center, Advanced ICT Research Institute

◎Co-recipients
Toru KINOSHITA (Tokuyama Corporation, Kobe University)
Toshiyuki OBATA, Toru NAGASHIMA,
Hiroyuki YANAGI (Tokuyama Corporation)
Baxter Moody, Seiji MITA (HexaTech)
Yoshinao KUMAGAI, Akinori KOUKITU (Tokyo University of Agriculture and Technology)
Zlatko Sitar (HexaTech, North Carolina State University)

◎Award Date: September 17, 2014

◎Name of Award: JSAP Paper Award

◎Details:
Performance and Reliability of Deep-Ultraviolet Light-Emitting Diodes Fabricated on AlN Substrates Prepared by Hydride Vapor Phase Epitaxy

◎Awarding Organization:
The Japan Society of Applied Physics

◎Comment from the Recipients:

This award is given for an excellent paper contributing to the advancement of applied physics, and in this case recognizes the achievement of research results contributing to the improvement of efficiency and reliability of deep-ultraviolet (DUV) LEDs, as published in the Applied Physics Express. I would like to express sincere thanks to all collaborating researchers and other related parties. Utilization of DUV LEDs is anticipated in a wide range of fields, from information and communications to environment, health and safety, and medicine. We will continue to work to develop this research further.

Recipients ● **Yasunori OWADA**/ Senior Researcher, Wireless Mesh Network Laboratory, Resilient ICT Research Center
Kiyoshi HAMAGUCHI/ Director of Wireless Mesh Network Laboratory, Resilient ICT Research Center

◎Co-recipients
Meng Li (Tohoku University)
Hiroki NISHIYAMA (Tohoku University)

◎Award Date: September 26, 2014

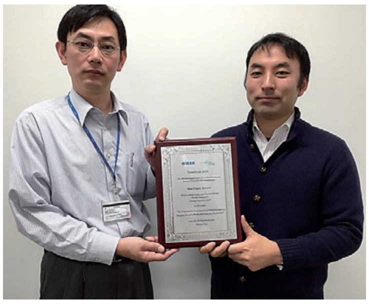
◎Name of Award:
TrustCom 2014 Best Paper Award

◎Details:
On Energy Efficient Scheduling and Load Distribution Based on Renewable Energy for Wireless Mesh Network in Disaster Area

◎Awarding Organization:
IEEE Computer Society

◎Comment from the Recipients:

This announcement is regarding an award received for a paper on technology for low-energy operation of wireless mesh networks that are disaster resistant resulting from joint research with Tohoku University. Our goal was a technology that would be useful in a real, large-scale disaster, and we are very happy that the research is being recognized. I would like to express deep gratitude to all those involved, within and outside the Institute. Encouraged by this award, I will continue to devote myself to contributing to research in disaster-resistant ICT in the future.



From the left: Kiyoshi HAMAGUCHI, Yasunori OWADA

Recipient ● **Ryu IIDA**/ Senior Researcher, Information Analysis Laboratory, Universal Communication Research Institute

◎Co-recipients
Mamoru KOMACHI (Tokyo Metropolitan University)
Naoya INOUE (Denso Corporation, Tohoku University)
Kentaro INUI (Tohoku University)
Yuji MATSUMOTO (Nara Institute of Science and Technology)

◎Award Date: October 4, 2014

◎Name of Award: 20th Anniversary Paper Award

◎Details:
Annotating Predicate-Argument Relations and Anaphoric Relations: Findings from the Building of the NAIST Text Corpus

◎Awarding Organization:
The Association for Natural Language Processing

◎Comment from the Recipients:

We are extremely pleased that our research was selected for the Association for Natural Language Processing 20th Anniversary Paper Award. In this research, we precisely defined the tasks of predicate-argument structure analysis and anaphora resolution in Japanese, and we manually built a large-scale annotated corpus according to the definition. The corpus has been downloaded over 450 times since it was released, and has been widely used by many researchers of natural language processing. The research results using our corpus have been presented at major international conferences of natural language processing.

Recipient ● **Takenari KINOSHITA**/ Researcher, Integrated Science Data System Research Laboratory

◎Award Date: October 22, 2014

◎Name of Award:
Meteorological Society of Japan Yamamoto Award

◎Details:
Research work advocating a new theory describing the 3D structure of general atmospheric circulation

◎Awarding Organization:
The Meteorological Society of Japan

◎Comment from the Recipient:

I recently received the Yamamoto Award from the Meteorological Society of Japan, recognizing two papers about a new theory describing the 3D structure of atmospheric general circulation. This research develops a wave theory in atmospheric dynamics, and enables a 3D picture, of materials circulation driven by waves, to be determined from observed data.

I would like to take this opportunity to express deep thanks to all providing guidance and advice in this work. I will continue my efforts in this research and work to take it still further.

From the left: Takenari KINOSHITA, Hiroshi NIINO, Executive Board of Meteorological Society of Japan (Professor of Atmosphere and Ocean Research Institute, The University of Tokyo)

Recipients ● **Guillermo Horacio Ramirez Caceres**/ Researcher, Information Services Platform Laboratory, Universal Communication Research Institute
Koji Zettsu/ Director, Information Services Platform Laboratory, Universal Communication Research Institute

◎Award Date: October 23, 2014

◎Name of Award:
CSS2014 Concept Paper Award

◎Details:
The paper, "Provenance-Based Risk Management for Secure Use of Open Data" won the Concept Paper Award, in that it is evaluated as pioneering research on security risk management for leveraging open data

◎Awarding Organization:
Computer Security Symposium 2014 (CSS2014), Information Processing Society of Japan

◎Comment from the Recipients:

We are conducting R&D on methods for analyzing provenance (chronology of reuse) of open data to evaluate security risks in use of the data, such as confidentiality, consistency, and availability. The paper describes a framework for diagnosing security risks based on provenance and was evaluated highly as a pioneering paper that should invigorate research in the future. It was the only one selected of 287 papers. I would like to express sincere thanks to all of those involved.

On the right: Guillermo Ramirez

Public Forum of The Third UN World Conference

Disaster Resilient ICT Research Symposium

—Establishing disaster resilient ICT research and societal implementation—

NICT Resilient ICT Research Center will be holding a Disaster Resilient ICT Research Symposium as part of public forum of the Third UN World Conference on Disaster Risk Reduction, being held from March 14 to 18, 2015, in Sendai City. With a keynote speech and panel discussions including speakers from overseas, we are going to introduce our R&D activities on disaster-resistant ICT at NICT Resilient ICT Research Center, Resilient ICT Forum activities and social implementations via academic-industrial-government alliance, and disaster risk reduction in Asian countries.

Date: **March 16, 2015 15:00-19:00**
Location: Tkp Garden City Sendai Hall D (AER 30th floor)
Admission: Free, advance registration required.
Japanese-English simultaneous interpretation provided.
For details, see: http://www.nict.go.jp/reict/symposium2015/ (Japanese only)

Announcement of the introduction of a "leap second"

July 1 of this year will be one second longer

NICT maintains Japan Standard Time and notifies the public of it.
On Wednesday, July 1, 2015, NICT will insert a leap second for the first time in three years.

[Adjustment with a leap second]
Between 8:59:59 a.m. and 9:00:00 a.m. on Wednesday, July 1, 2015, 8:59:60 will be inserted.

Time was formerly determined using astronomical time (universal time), based on the period of revolution and the axial rotation of the Earth. In 1958, however, international atomic time (TAI), based on an atomic clock utilizing oscillations of atoms, was instituted. This method allows us to determine the length of a second with high accuracy, whereas astronomical time slowly drifts away from atomic-clock time.

Leap seconds compensate for this drift. The world's standard time (coordinated universal time) is adjusted to prevent the difference between atomic clock-based time and astronomical time from exceeding 0.9 seconds. A leap second has been inserted about once every several years since 1972. This is the 26th time and the first in three years. In addition, this is the first time since 1997 to make a leap-second adjustment on a weekday.

When the International Earth Rotation and Reference Systems Service (IERS, Paris), an international body that observes the Earth's rotation, makes an announcement, a leap second is applied simultaneously around the world.

Please see the following NICT Web site for "International Atomic Time (TAI), Coordinated Universal Time (UTC), and Leap Seconds."
http://jjy.nict.go.jp/mission/page1-e.html

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〈Recycled Paper〉